U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
OFFICE OF QUALITY ASSURANCE

AUDIT REPORT

OF

CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM
MANAGEMENT AND OPERATING CONTRACTOR

LAS VEGAS, NEVADA

AUDIT M&O-ARP-99-012

JULY 12 through JULY 21, 1999

Prepared by:_____ **Date:**_____
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1.0 EXECUTIVE SUMMARY

As a result of the Quality Assurance (QA) Performance Based Audit M&O-ARP-98-012 conducted in Las Vegas, Nevada, July 12 through July 21, 1999, the audit team determined that the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) is satisfactorily implementing an effective QA program and process controls for design control. Activities and products pertaining to License Application Design Selection (LADS), Waste Package (WP) design, Engineered Barrier System (EBS) design and the System Description Document (SDD) processes were evaluated.

The audit process included reviews of the pertinent documentation relative to selected design deliverables, interviews with management and design personnel responsible for the process and products, follow-up to the past Design Control Audits (M&O-ARP-98-02 and M&O-ARP-98-015), follow-up on deficiencies identified since the last audits, and, direct observations of the design process. The audit team analyzed and evaluated information gained throughout this process in order to make a determination whether or not the performance was satisfactory.

The audit team identified two deficiencies during the audit. One was determined to be another example of the deficient conditions addressed in Corrective Action Report (CAR) 98-C-002, and the other was a records anomaly that was corrected during the course of the audit. These conditions are described in paragraph 5.5 of this report. Additionally, there were five recommendations resulting from the audit, which are detailed in paragraph 6.0 of this report.

The audit team found the problems identified in the previous audit to have been adequately resolved, that design deficiency documents issued subsequent to the previous audits were adequately resolved, and that the current deficiencies do not impact the quality or integrity of the resultant end products. The design program now in place is effective and satisfactorily implemented.

2.0 SCOPE

This was a limited scope audit of design control activities pertaining to LADS, WP design, EBS design and the SDD processes in Las Vegas, Nevada, performed by a team of auditors from the Office of Quality Assurance (OQA) and two Technical Specialists from the Yucca Mountain Site Characterization Office (YMSCO). The audit team evaluated the effectiveness of selected design processes, and the quality of the resultant end products (detailed below) through an assessment of the design to the critical process steps developed by the audit team and the CRWMS M&O management organization.

The audit was intended to determine the degree to which CRWMS M&O design results meet program requirements, e.g., Quality Assurance Requirements and Description (QARD) document (Department of Energy (DOE)/RW-0333P, Revision 7), Section 3.0, and management commitments and expectations. The processes/end-products for the repository design were evaluated during the audit, in accordance with the audit plan.

PROCESS/ACTIVITY/END-PRODUCT

The following deliverables were evaluated during the audit:

Reports
B00000000-01717-4600-00123, Revision 1, *LADS Report*
B00000000-01717-5705-00095, *Disposal Criticality Analysis Methodology Topical Report, Rev ICN 0,* 11-30-98 YMP / TR - 004Q
BCAA00000-01717-0200-00010, *Evaluation of Ground Support Heating & Cooling Cycles*
BCAD00000-01717-2200-00002, *Continuous Preclosure Ventilation*
B00000000-01717-2200-00215, *Richards Barrier*
B00000000-01717-2200-00216, *Waste Package CRMs*
B00000000-01717-2200-00211, *LADS Canistered Assemblies*
B00000000-01717-2200-00220, *Waste Package Self Shielding* and
(BCAA00000-01717-0200-00011, *Repository Layout Supporting DF #13, Waste Package Self Shielding*)
BCA000000-01717-2200-00002, *Repository Horizon Elevation*

System Design Documents
SU40 *Emergency Response*
SS 26 *Subsurface Fire Protection*
SU02 *Waste Handling Building*
WP01 *Uncanistered SNF Disposal Container*
SU55 *Performance Confirmation Data Acquisition/Monitoring*
SU29 *Site Radiological Monitoring System*
SS17 *Waste Emplacement System*
SU16 *Carrier/Cask Transport*

The performance-based evaluation of process effectiveness and product acceptability was based on:

1. Satisfactory implementation of the critical process steps.
2. Demonstrated adherence to management and performance objectives.
3. Use of trained and qualified personnel working effectively.
4. Documentation that substantiates the quality of the products.

5. Acceptable results and adequate end products.

The following critical process steps were considered during the evaluations of design processes and associated products:

1 Control of *design inputs*
2. Control of *design process*
3. Control of *design analyses*
Control of *design interfaces*
Checking process
Change control
7. Design outputs
8. Comment resolution
9. *Design reviews /*Final product deliverable

TECHNICAL AREAS

The audit included a technical evaluation of process effectiveness and product acceptability. Details of the technical evaluation are included in paragraph 5.4.

3.0 AUDIT TEAM AND OBSERVERS

Name/Title/Organization

Kenneth O. Gilkerson, Audit Team Leader, OQA
Robert F. Hartstern, Auditor, OQA
Michael A. Goyda, Auditor, OQA
James Blaylock, Auditor, OQA
Paul Harrington, DOE, YMSCO, Las Vegas, NV, Technical Specialist
Frank Bugg, MTS, Booz-Allen & Hamilton Associates, Inc., Technical Specialist

There were five observers present at the audit:

Ted Carter, U.S. Nuclear Regulatory Commission (NRC), Washington D.C.
Dr. Mysore Nataraja, U.S. NRC, Washington D.C.
Rod Weber, Center for Nuclear Waste Regulatory Analyses (CNWRA), San Antonio, TX
Simon Hsiung, CNWRA, San Antonio, TX
Engelbrecht Von Tiesenhausen, Clark County, Las Vegas, NV

The Las Vegas U.S. NRC On-Site Representatives Bill Belke and Chad Glenn also participated as observers during portions of the audit.

4.0 AUDIT MEETINGS

The pre-audit meeting was held at CRWMS M&O facilities at Summerlin in Las Vegas, Nevada, on July 12, 1999. A daily debriefing and coordination meeting was held with CRWMS M&O management and staff, and daily audit team meetings were held to discuss issues and potential deficiencies. The audit was concluded with a post-audit meeting held at the CRWMS M&O facilities in Las Vegas, Nevada on July 21, 1999. Personnel contacted during the audit are listed in Attachment 1 of this report. This list includes an indication of those who attended the pre-audit and post-audit meetings.

5.0 SUMMARY OF AUDIT RESULTS

5.1 Program Effectiveness

The audit team concluded that the CRWMS M&O, with the exception of the areas identified in the two deficiencies, is satisfactorily implementing an effective QA program and process controls for design control activities and products pertaining to LADS, WP design, EBS design and the SDD processes.

The audit team found the problems identified in the previous audits to have been adequately resolved, that design deficiency documents issued subsequent the previous audits were adequately resolved, and that the current deficiencies do not impact the quality or integrity of the resultant end products. The design program now in place is effective and satisfactorily implemented.

5.2 Stop Work or Immediate Corrective Actions or Additional Actions

None

5.3 QA Program Audit Activities

A summary table of audit results is provided in Attachment 2. The details of the audit evaluation, along with the objective evidence reviewed, are contained within the audit checklists. The checklists are kept and maintained as QA Records.

5.4 Technical Activities

Two Design Analyses, eight Technical Reports and eight SDDs selected for evaluation were found in general to be satisfactory, with the exception of one deficient condition regarding the qualification status of data. Additionally, a checklist record was deficient relative to a missing identifier. This deficiency was isolated in nature and corrected during the course of the audit.

These deficient conditions are identified in paragraph 5.5 of this report. While there were no specific conditions that directly impacted the results of the analyses or reports, improvements in the processes can be made. These are identified in paragraph 6.0 as process recommendations. It was recognized during the audit that CRWMS M&O design personnel generally adhered to the design processes depicted in the Design Guidelines Manual (DGM), although recommendations are made in paragraph 6.0 to clarify the processes. Some differences in the documentation methodologies used were denoted in the checking process and a process recommendation was made relative to this.

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The SDD process was evaluated during the audit to determine the adequacy of the planning, identification, preparation, check, review, and approval processes. The SDD development process was found to be effective with no identified deficiencies. The products reviewed appear adequate for their intended purpose. Cognizant personnel are involved in the development, review, and approval processes. Three process improvement recommendations were made in the areas of: 1) the identification and use of huddle team members; 2) incorporation of Compliance Program Guidance Packages (CPGP) in the SDDs; and 3) maintenance of information contained in the Lotus Notes pertaining to SDDs.

Specific comments relative to the assessments of the selected design products are as follows:

License Application Design Selection Report (LADS)
B00000000-01717-4600-00123

This report was developed in accordance with M&O QAP-3-5 and submitted to the DOE as a product deliverable initially as a Revision 0. The LADS report itself is considered more of a decision making document that presents a number of design alternatives and the rational for the recommendation of a particular Enhanced Design Alternative (EDA) than as a technical analysis. This document was developed based on the numerous QAP-3-5s that evaluated as an analysis for each of the EDAs considered for design selection. These QAP-3-5 reports were the building blocks for this LADS document. They included such QAP-3-5 evaluations as *Continuous Preclosure Ventilation* (BCAD00000-01717-2200-00002), *Richards Barrier* (B00000000-01717-2200-00215), *Near Field Rock Treatment During Construction* (BCAA00000-01717-2200-00005), *Higher Thermal Loading* (B00000000-01717-2200-00218), *Enhanced Design Alternative I* (BCAA00000-01717-2200-00006), *Waste Package CRMs* (B00000000-01717-2200-00216), *LADS Canistered Assemblies* B00000000-01717-2200-00211, *Waste Package Self Shielding* (B00000000-01717-2200-00220), *Repository Horizon Elevation* (BCA000000-01717-2200-00002), and numerous others.

The QAP-3-5 documents listed here are ones from which the audit team selected to evaluate. The audit evaluations of these products follow in this report.

The development of the LADS report was evaluated by review of the Technical Document Preparation Plans (TDPP), interviews of cognizant personnel and examination of review documentation. The LADS R-0 QAP 3-5 review while meeting procedural requirements lacked the rigor and detail that is generally found in other QAP-3-5 reviews. Only one of the five reviewers documented any "mandatory" comments. Discussions disclosed that due to the nature of the document the only formal review would be by senior management. When this same document was submitted to the DOE for acceptance a QAP 6.2 review was performed resulting in over 300 comments, most of which were mandatory and approximately 200 were incorporated as changes to the document. Revision 1 reflected significant changes based on these comments. Revision 2 was in process during the audit to incorporate comments from the Nuclear Waste Technical Review Board. While none of the comments changed the output of the document, i.e., the considered and recommended EDAs, they did address transparency issues and result in clarifications relative to understanding the rationales in supporting the information presented.

Overall, the LADS report was found to be a credible document and an acceptable product. Critical process steps were found to be adequately implemented. One condition adverse to quality was identified. A deficiency relative to the traceability of a Technical Document Checklist (B00000000-01717-4600-00123) submitted to records was identified during the audit. A correction to this record was processed by Engineering Document Control (EDC). See paragraph 5.5.2.

Richards Barrier LA Reference Design Feature Evaluation
B00000000-01717-2200-00215

This was a performance based audit of the results and processes used to plan, prepare, check, review and approve the Richards Barrier License Application Reference Design Feature Evaluation document dated April 7, 1999. The audit was structured around resolving technical questions identified in the Performance Based Checklist M&O-ARP-99-012-01 through a combination of interviews and records package research.

The interview portion of the audit included 3 separate discussions. An initial interview was conducted with the author and CRWMS M&O design managers. The discussion addressed the QA Checklist questions, e.g., personnel qualifications, management oversight, control of the document development process, etc. The interview determined that the author and management had

adequately planned and prepared the document using clearly defined objectives, design criteria and traceable inputs. The discussion also covered the author's role in resolving comments from the checker and reviewers. Finally, the discussion identified inputs to the documents that were developed externally, e.g., long-term dose rate calculations.

The second Richards Barrier interview was with the checker. He used the check copy, back-check copy and final check copy of the document to describe his role in the development of the document. The interview verified that the checker was technically qualified (a mining engineer) and had performed an adequate check of the document. One anomaly was denoted relative to the ability to examine these records. The copies reviewed during the interview were imaged from the original mark-ups. Portions of the original copies contained color mark-ups that were not legible on the imaged versions. Consequently, a review of the imaged copies could not completely verify adequate checking. A request was made to the records group to retrieve the originals containing the color mark-ups. A review of the originals verified that the document had been adequately checked. A process recommendation was made by the audit team relative to the methodologies utilized by the checkers to document their checks and back-checks and records processing. See process recommendation number five in paragraph 6.0 of this report.

The third interview was with the head of the performance assessment modeling team. He was responsible for providing the long-term dose rate calculations from the RIP model for input to the Richards Barrier document. The discussion identified how RIP used multiple inputs based on the Viability Assessment (VA) reference case along with the assumption that WP degradation would be delayed while the Richards Barrier was effective to determine long-term dose rates. RIP is a fully qualified model and the development of the analysis was controlled by an existing procedure (AP 3.10Q).

The last step of this evaluation included a review of references and reviewers comments contained in the record package. Two references were reviewed to verify that inputs to the Richards Barrier document were used correctly. Finally, the approved revision of the document was checked against marked-up copies from reviewers to verify that changes had been incorporated correctly and subsequently approved by the reviewers. No anomalies were identified. Critical process steps were adequately implemented and no conditions adverse to quality were identified. Overall the technical evaluation resulted in a "Satisfactory" evaluation for the Richards Barrier License Application Reference Design Feature Evaluation document.

Continuous Preclosure Ventilation
BCAD00000-01717-2200-00002

This was a performance based audit of the results and processes used to plan, prepare, check, review and approve the *Continuous Preclosure Ventilation* technical report document dated June, 1999. The audit was structured around resolving questions identified in the Performance Based Checklist M&O-ARP-99-012-01 through a combination of interviews, reference checks, and verifying calculations.

The interview portion of the audit included four separate discussions. An initial interview was conducted with the author. The author's manager and group manager also attended this discussion. The discussion addressed the QA Checklist questions, e.g., personnel qualifications, management oversight, control of the document development process, etc. The interview determined that the author and management had adequately planned and prepared the document using clearly defined objectives, design criteria and traceable inputs. The discussion also covered the author's role in resolving comments from the checker and reviewers. Finally, the discussion identified inputs to the document that were developed with software, e.g., ventilation calculations from VNETPC.

The second Continuous Preclosure Ventilation interview was with the Compliance Checker (this document used two Checkers, i.e., Compliance and Technical). The Compliance Checker’s job was two-fold. First he ensured that the applicable procedure, QAP-3-5, was used correctly to check, back-check and final check document. Secondly, he provided guidance to the Technical Checker related to procedural requirements for checking as she conducted her work. He found no major problems with the document during his check. The interview verified that the Compliance Checker was technically qualified (a mining engineer) and that he ensured the document checking process was in compliance with QAP-3-5.

The third interview was with the Technical Checker. The author’s managers also attended the interview. The Technical Checker (a mining engineer) described how she used the check, back check, and final check copies to verify that the author had complied with the procedure, ensured the document was accurate, and incorporated comments from the reviewers and herself. She characterized the check as having found few technical problems with the report. However, documenting references and ensuring traceability of inputs required extensive work by the author during the checking process. No problems were identified by the audit.

A fourth interview was with the modeler responsible for providing the ventilation

calculations from the VNETPC model for input to the Continuous Preclosure Ventilation document. The discussion identified how VNETPC used multiple inputs based on the VA reference case along with assumptions related to additional shaft dimensions and the air volume requirements for the 3 alternative cases to determine fan horsepower requirements. VNETPC is a fully qualified software tool. No problems were identified by the audit.

The last step of the audit was a review of references. Two references were reviewed to verify that inputs to the Continuous Preclosure Ventilation document were used correctly. Finally, spot checks of ventilation calculations contained in the document were completed. The reference and calculation check found no problems.

Critical process steps were adequately implemented and no conditions adverse to quality were identified. Overall the technical evaluation resulted in a "Satisfactory" evaluation for the Continuous Preclosure Ventilation document.

Waste Package CRMs, B00000000-01717-2200-00216
LADS Canistered Assemblies, B00000000-01717-2200-00211
Waste Package Self Shielding, B00000000-01717-2200-00220
(BCAA00000-01717-0200-00011, *Repository Layout Supporting DF #13, Waste Package Self Shielding*)

Interviews and documentation reviews were conducted to evaluate the process controls for development of the three Waste Package Organization (WPO) Design Feature Reports as inputs to the LADS. This revealed that the WPO utilized appropriately trained personnel in performing the preparation, review and approval of each Design Feature Report reviewed. The detailed lists of persons interviewed, checkers and objective evidence reviewed is captured in the Audit Checklist M&O-ARP-99-012-01.

For each of the listed Design Feature Reports, design activities have been limited to a conceptual nature as presented. In addition, each design feature report identifies the use of unqualified inputs. As such, the reports are unqualified and contain a disclaimer to the effect that any data for input into documents supporting procurement, fabrication or construction will require to be controlled as TBV in accordance with appropriate procedures.

The WPO method for preparing, reviewing and approving each Design Feature Report was also examined. Without exception, the WPO prepared and utilized Technical Document Preparations Plans (TDPP) to guide the development of each Design Feature Report. In each case examined, the WPO successfully controlled and delivered the development and issuance of the Design Feature Reports that

included appropriate design interface reviews by supporting technical disciplines, control of comment resolution and use of Design Input Transmittals.
While each of the three TDPP's that support the Design Feature Report development provided a section identifying "Sources of Requirements", two Design Feature Reports (noted in the audit checklist) were particularly weak in identification of design requirements. This condition was discussed with WPO management. While this condition was noted, this is not viewed as a deficiency, since the sampled reports themselves are noted with a qualifying statement to the effect that the results of each report are not to be utilized to perform procurement, construction or fabrication activities. This condition resulted in an audit team process recommendation. See process recommendation number three in paragraph 6.0 of this report.

Relative to assumptions, the three listed Design Feature Reports did not contain a direct identification of assumptions, however a sample of analyses and calculations from the listed references within each report was examined. Each of the listed reference documents examined contained assumptions for the type of analysis or calculation completed that were then used as a portion of the input to the corresponding Design Feature Report. It was further noted during the interviews that new or evolved design activities *post* LADS Reference Report would include verifications of all inputs utilized under the auspices of the newly released Process Validation and Reengineering (PVAR) process procedures.

Overall, the technical reports evaluated were of adequate quality and were an acceptable product. Critical process steps for these three technical reports were adequately implemented and no conditions adverse to quality were identified.

Repository Horizon Elevation, Design Feature Evaluation #25
BCA 000000-01717-2200-00002

Design Feature Evaluation #25 considered four alternatives to the VA design: raising the repository horizon 50 meters, keeping the repository horizon in a single lithophysal unit, and two, two tiered designs, a full sizes two tiered VA design and a half-sized two tiered design. None of these alternatives were considered in the enhanced design alternatives.

The technical document was prepared in accordance with QAP 3-5. Personnel were trained to the procedure, design inputs were controlled, and the document had a formal technical review. The document had two controlled design inputs, MOL 19990526.0187 and MOL 19990321.025. The final approved document was issued with a June 1999 date.

There was a single identified concern. The document's single qualified input

MO9808RIB00041.000 was changed from *qualified* to *non qualified* by the data base administrator on 6/22/99. The report still identified this input as qualified, however, as part of LVMO 98-C-002, all qualified data in the project databases should have been flagged with a To Be Verified (TBV) status several months ago. This change to the status was not reported to the document authors, although a system was instituted to do this about 6/30/99. In this case there is no impact on the report. This deficient condition was identified to the QA Representative for LVMO-98-C-002 via a Deficiency Identification and Referral form per AP 16.1Q.

Overall, the *Repository Horizon Elevation*, Design Feature Evaluation #25 was of adequate quality. Critical process steps for this technical report were adequately implemented with one condition adverse to quality identified.

Evaluation of Ground Support Heating & Cooling Cycles
BCAA00000-01717-0200-00010

The technical evaluation performed relative to this analysis included interviews of CRWMS M&O design personnel and detailed reviews of pertinent design development documentation. This evaluation specifically addressed inputs, assumptions, software, analysis, and technical independent review. Two process recommendations were made as a result of this evaluation and are discussed in the following paragraphs. This evaluation, as well as the following Disposal Criticality Analysis, was conducted by the DOE Audit Team Technical Specialist.

Inputs

Assumptions were reasonable. Selected assumptions were checked against source documents and were generally correct. However, one error was identified. Table 4-10 was checked against Reference 5.1, Section 4.3.17, and had two values transposed. The normal contact stiffness for steel/rock should be $5x10^{3,}$ and the sticking contact stiffness for concrete/rock should be $3x10^{3.}$ The calculations that used these values were checked, and the proper values were used in the calculations. A recommendation was made relative to this. See process recommendation number one in paragraph 6.0 of this report. Further design products were reviewed in subsurface and surface areas to determine if this was an isolated occurrence or a systematic problem. No further occurrences were found. Additional products examined included BCAA00000-01717-0200-00016, Revision 00, *Full Periphery Geotechnical Mapping, Strike and Dip Data Entry Correction Analysis*, BCBD00000-01701-5705-00002, Revision 00, *Cask/Canister Cooldown System Technical Report*, and BCBD00000-01717-0200-00025, Revision 00, *Secondary Low-Level Waste Treatment Strategy Analysis.* The equations used were appropriate to the work and used in an appropriate manner. All inputs checked were current.

The TBVs were generally acceptably treated, but in some cases were not uniformly explicit nor based upon demonstrable requirements. Tables 4-3 and 4-4 correctly refer to TBV-461, but using one TBV to cover many parameters does not provide explicit control and will lead to difficulty when some parameters become known while others remain unknown. Paragraph 4.2.4 correctly transcribed the requirements of TBV-335, but the source SDD did not have a basis for selection of either the 5% maintenance or the 95% confidence level, and the backup of the SDD made an incorrect logic statement that linked the permissible amount of maintenance with the confidence level.

Assumptions

The audit discloses that both real assumptions (due to lack of data) and "interim" assumptions (current design approach, e.g., drift spacing) are treated the same. Both types of assumptions analyses will be required to close either assumption. With the exception of the transposed input discussed above, all design parameters reviewed were acceptable (i.e., legitimate, qualified, traceable).

This analysis did not identify any applicable codes or standards, although as previously discussed, the allowable stress values for structural steel and concrete are fundamental to the analysis. In the absence of invoking industry consensus codes or standards, project-specific allowables may be developed, but were not. In the absence of specifically defining allowablels, the analysis correctly identified overstress situations and imposed design solutions in the form of compressible elements to limit stresses to acceptable values. Comparing Table 4-7 and Figure 7-29 indicates that the steel sets would see no more than about half their yield strength, and comparing Table 4-6 and Figure 7-26 indicates that the concrete would see slightly more than half of its design mix compressive strength. As indicated in the previous paragraphs, a recommendation was made relative to this. See process recommendation number one in paragraph 6.0 of this report. The additional products reviewed disclosed that codes and standards were appropriately identified as required.

Computer software

An appropriate computer code was used for the condition being modeled. Based upon work experience, the design engineer appeared to be adequately qualified for use of the code.

Analysis

The analysis is clear enough to be independently reviewed, the methodology was determined to be appropriate for the subject, and the simplifications are adequately justified. Overall, the analysis methodology was clearly described.

Technical Review/Checking

An independent technical review was performed with qualified staff through the checking process performed by the Product Checking Group. Questions were raised during the audit relative to how CRWMS M&O design satisfied the independent review process described in 10 CFR, Appendix B, Criterion III, NQA-1 and the QARD. Issues revolve around past use of "package" concepts for design and current "products" concept and when a design is "complete." Interviewed personnel provided inconsistent responses relative to performing design verification. After a number of meetings and reviews of the independent checking criteria used by the CRWMS M&O, it was determined that the actions actually being performed meets the QA program requirements. It is not evident that CRWMS M&O design procedures clearly depict how the design verification or independent checking requirements are met and for what design products. A recommendation was made relative to this. See process recommendation number two in paragraph 6.0 of this report.

Critical process steps for the *Evaluation of Ground Support Heating & Cooling Cycles* analysis were adequately implemented and no conditions adverse to quality were identified. Overall the technical evaluation found this product to be an adequate and satisfactory design product.

Disposal Criticality Analysis Methodology Topical Report, Rev ICN 0, 11-30-98 B00000000-01717-5705-00095 (issued as DOE document YMP / TR - 004Q)

The technical evaluation performed relative to this analysis included interviews of CRWMS M&O design personnel and detailed reviews of pertinent design development documentation. This evaluation specifically addressed inputs, calculations, methodology, assumptions, and reasonableness of outputs for this analysis. The design characteristics addressed in the previous analysis were reviewed as applicable to this methodology, and no problems were identified.

Inputs

Selected inputs, such as Tables 3-1 and 4-4, were reviewed against source documents and found acceptable. Applicable codes and standards were identified. To Be Determined /To Be Verified (TBX) and were appropriately controlled. The inputs for the analyses are described in detail throughout Section 4, within the discussions of the various model components of the overall methodology.

Methodology

The proposed methodology was evaluated and appears reasonable. The report provides a complete discussion of each step of the approach for evaluating potential criticalities for each different fuel type, and includes numerous flow charts describing the process. Examples include Figure 1-1 and 3-3. Section 3 provides an overview of the methodology, and section 4 provides a detailed

discussion of the various models included in the methodology.

Outputs

An evaluation of how outputs are justified and if they are reasonable compared to design inputs was performed to assess whether inputs appropriately translated into the design outputs. The outputs are not contained within the methodology, but will be developed within the specific analyses. If the approach defined by the methodology is followed, the outputs will have an adequate technical basis to support the analysis conclusions.

Reasonableness of Outputs

The audit evaluated if the application of a probabalistic approach was reasonable, and if not, what alternatives may be appropriate. It was determined that the application of a probabalistic approach was reasonable based upon a review of the methodology contained in this report, and, based on consideration of the issue of evaluating potential criticalities over not only the preclosure period but the postclosure period as well. The alternative would be application of a deterministic approach, but the uncertainties involved over the time period of interest render that approach unreasonable.

Critical process steps for the *Disposal Criticality Analysis Methodology Topical Report* were adequately implemented and no conditions adverse to quality were identified. Overall the technical evaluation found this product to be an adequate and satisfactory design product.

SDD Processes

The SDD evaluation was performed by selecting eight SDDs from the SDD Schedule FY 99, dated 5/14/99, and the Lotus Notes SDD Database. Four approved SDDs with different SDD originators and four SDDs in the development process were selected for evaluation. For the approved SDDs, the record package for each was evaluated to determine performance and process adequacy.

Four approved SDDs and corresponding record packages selected were:

SU 40, *Emergency Response* – BCB000000-01717-1705-00009, Revision 00
SS 26, *Subsurface Fire Protection* - BCA000000-01717-1705-00006, Revision 00
SU 02, *Waste Handling Building* - BCB000000-01717-1705-00027, Revision 00
WP 01, *Uncanistered SNF Disposal Container* - BBA000000-01717-1705-00004, Revision 01

Four SDDs in various stages of development selected were:

SU 55, *Performance Confirmation Data Acquisition/Monitoring*
SU 29, *Site Radiological Monitoring System*
SS 17, *Waste Emplacement System*
SU 16, *Carrier/Cast Transport*

The initial basis for the SDD selection was the Mined Geologic Disposal System (MGDS)-Requirements Document (RD). The MGDS-RD has been replaced by the Monitored Geologic Repository (MGR)-RD. The initial SDDs were established by identifying the essential systems to be described from the requirements in the MGDS-RD. The list was refined and some SDD combined and others added. There are 38 "Q" and 24 conventional SDD's at this time. The documents used initially to determine scope and contents of SDDs were the Control Design Assumptions (CDA), Engineered Barriers-RD and the Repository-RD. These documents have been archived. At this time a Project Description Document (PDD), which is the hierarchy flow between the MGR-RD and the SDDs is being developed. The PDD will contain the common and generic requirements instead of having them repeated in each SDD. The MGR architecture, dated May 26, 1999 contains the plan for the MGR architecture and corresponding SDDs. A SDD Schedule FY 99 is updated regularly to document the status of SDD development and currently the SDD Quality Levels are being classified.

The SDDs are prepared in accordance with M&O Procedure NLP-3-33 that describes the preparation, check, review and approval process. The preparation, check, review, and approval processes were found to be consistent with the development of other Yucca Mountain Site Characterization Project design documents. Huddle teams made up of engineers from the organizations that will be affected by the document are used in the preparation of each SDD. However, the selection and use of huddle teams are not identified in the procedure, and the Audit Team recommended that their use and identification be added to the procedure. See recommendation number four in paragraph 6.0. During SDD preparation, the SDD Originator and huddle team reviews the MGR-RD and allocates the applicable requirements to the SDD. 10CFR60 is also reviewed for applicable requirements. The SDD Originator and huddle team also input the applicable requirements of national codes and standards (e.g., NFPA, ANSI/ANS, etc.) based on their expertise of the system. In addition, CPGP are developed specifically for each SDD in accordance with NLP-3-36 for input by the SDD Originator during the SDD development. These CPGP are developed based on the contents and scope of the SDD. The CPGPs contain all the applicable NRC "design criteria" that might impact a specific SDD. The CPGPs have the same process for check, review and approval as other design input. However, the CPGPs for several of the Revision 00 SDDs and some Revision 01 SDDs, were not available at the time of the SDD preparation or revision and not included. The procedure for SDD preparation, NLP-3-33, does not require input of the CPGP, if one has not been prepared. The Audit Team has recommended that if the CPGP is not available, the SDD clearly state this fact, and that a strategy to complete and incorporate the CPGPs be developed. See recommendation number four in

paragraph 6.0.
All the requirements of the MGR-RD and 10CFR60 are contained in Volume I in Criterion Basis Statements with reference to the specific sections containing the requirement in brackets. All design inputs and requirements are identified in the text of the SDD and the revision or version used is contained in a listing of references. The requirements are expanded in Volume II to establish the criterion need and the performance parameter basis. The SDD preparation is performed using Microsoft Access, Requirements Document Development Tool. This system automatically tracks the requirements to the specific SDDs referencing the requirement. It does not automatically identify revisions in references, but a query can be written to identify all the SDDs containing the requirement. It was reported that the new Document Input Reference Sheet (DIRS) database will identify all the SDDs and the references contained in each. As references are revised, the DIRS will have the capability to automatically identify which SDDs are affected and an impact analysis can be performed to determine if the SDD needs revision.

Type I Analyses contained in the SDDs were also reviewed. However, only a few have been completed for the initial SDDs. Additional Type I Analyses will have to be performed in future SDD revisions and are identified by TBX numbers in the current approved SDDs. A Type I Analysis was reviewed by the Technical Specialist for SDD SU WP01 – Uncanistered Spent Nuclear Fuel Disposal Container SDD, Revision 01, Volume II, Section 1.2.4.2, WP Emplacement Support Spacing. It was found acceptable. No other type of design analyses were included in the SDDs reviewed during the audit.

Several TBDs and TBVs identified in SDDs are controlled by unique numbers traceable to a database for controlling the TBD/TBVs. The numbers are identified in the Remarks Section of the SDD Cover Sheet and in the text, as applicable. Several TBXs were checked for application to the SDDs. These include TBD-396 for SS-26, Subsurface Fire Protection; TBV228 for all Revision 00 SDDs, which required an evaluation of the quality classification of the Revision 00 SDDs; and TB197, which was inadvertently added by the SDD Originator to SDD WP-01, Revision 01, and removed in the Checked Copy, because it did not pertain. The developers of the SDDs have no clear plan to resolve existing TBXs identified in the SDDs. However, with the implementation of the results of PVAR and new Procedure AP 3.15Q, TBXs should be resolved in a more timely manner in the future. In addition, the responsibility for the TBX process will be transferred to the newly titled Repository System Operations Organization, which will also be responsible for SDDs.

All SDDs are checked by the Product Checking Group using the same process as that implemented for checking other design documents. A SDD Checklist has

been developed and was found in use in checking SDDs. The current checklist #0865 is Revision 01/22/99 and is a controlled form. The checked documents are draft Revision A and the checker signs and dates the Check Copy cover sheet when he has completed the initial check. All the checker's comments are mandatory and must be resolved to the checker's satisfaction upon acceptance of Summary Form for draft Revision B that contains the resolved comments. After the reviewers' comments have been resolved and draft Revision C is issued, the checker performs a final check and signs the cover sheet of the Final Check Copy SDD draft Revision C as final check.

It was noted that there are in insufficient number of personnel in the Product Checking Group to perform all the required checks of design documents. As a result, the use of "satellite checkers" has become necessary. They are used to provide both technical checks and to support the Product Checking Group in completing the number of checks required. These are qualified personnel from within the System Engineering Group that have attended a workshop on the checking process. The workshop curriculum was reviewed by the Audit Team and found to be adequate to demonstrate the checking process. Records of the workshop attendance for several checkers were also reviewed. They also receive "on-the-job" training from an experienced checker from the Product Checking Group. In addition, all design documents checked by a satellite checkers receives a compliance check by the Product Checking Group prior to releasing the document back to the originator. The checking process appears thorough and professional.

The review of SDDs is performed on draft Revision B. The reviewers consist of the organizations that will be affected by the SDD, as well as OQA. One Master Review Copy of SDD, draft Revision B, is used for all the comments. The reviewers document their comments in this master and sign as the reviewer on the SDD Review Summary form. They also sign this form when their comments are resolved.

The four specific SDDs in various stages of development were found to be following the same process as the approved SDDs. However, SU 16, Carrier/ Cask Transport has had no work performed to date and no review was performed by the Audit Team. SU 29, Site Radiological Monitoring SDD was selected from the Lotus Notes SDD database as was all eight selected SDDs. For SU 29, this database contained a ten page "In-process Preliminary Draft 00A," titled, "SDD for the Waste Handling Building Radiological Monitoring System (SU 29)." The SDD Originator informed the Audit Team that this SDD has been revised to the new title (Site Radiological Monitoring) and the draft document in the Lotus Notes database for SDD SU 29 is no longer valid. The draft SDD is remaining in the database to help the assigned SDD Originator in the future. However, there is

no information identifying this anywhere in the database or the document. Several other errors were noted in the database, including no or incorrect information on the specific huddle team members and no information provided in the SDD schedule section of the SDD cover sheet. The Audit Team recommended that the Lotus Notes SDD Database information be kept up-to-date and those sections of the SDD coversheet not used be deleted. See recommendation number four in Paragraph 6.0.

For the four approved SDDs, the record packages were obtained and reviewed. The recorded packages contained the revised SDD's drafts A, B and C with the comments, the checkers' checklists, and reviewers' form. These packages were reviewed for the process, and the contents and resolution of comments. The contents of the record packages were found to be adequate to document the process. The SDD records packages requested for review by the Audit Team were retrieved in a timely manner with no difficulty.

In addition to the performance audit, the recommendations contained in the last audit of the SDD process were reviewed with Manager, Requirements Department. All of the recommendations have been incorporated to some degree in the revised procedures. The audit team is satisfied with resolution and incorporation of the recommendations.

5.5 Summary of Deficiencies

The audit team identified two deficiencies during the audit. One was corrected during the course of the audit and the other was another example of a deficient condition already addressed in CAR LVMO-98-C-002. A synopsis of the deficiencies documented is detailed below.

5.5.1 Deficiency Reports (DR)

As a result of the audit, no DRs were issued:

5.5.2 Deficiencies Corrected During the Audit

In accordance with QAP 18.2 deficiencies which are isolated in nature, have no impact on the quality of the product, and require only remedial action can be resolved prior to the audit exit. A deficiency relative to the traceability of a Technical Document Checklist (B00000000-01717-4600-00123) submitted to records was identified during the audit. A correction to this record was processed by EDC and subsequently reviewed by the auditor. It was appropriately corrected.

5.5.3 Follow-up of Previously Identified Deficiency Documents

A total of ten deficiency documents (DRs, PRs) were reviewed during the

audit. The review included both CRWMS M&O and OQA initiated deficiencies. The following deficiency documents were evaluated and discussed with the CRWMS M&O. Most were self- identified by the CRWMS M&O. No trends were denoted. Many of these DR/PRs identified problems that were in progress.

VAMO-98-D-066 LVMO-99-D-060 LVMO-99-D-056 LVMO-99-P-007 LVMO-98-P-008 LVMO-98-D-014
LVMO-98-D-039 LVMO-98-D-048 LVMO-98-D-050
LVMO-98-D-099

In reviewing the report on *Repository Horizon Elevation* it was identified that source data identified as "qualified" in the report was determined to be "not qualified" by TDMS prior to issuance of the report. This issue was determined to be another example of a condition cited in CAR LVMO-98-C-002. It was identified via a Deficiency Identification and Referral form per AP 16.1 Q to the CAR 002 QA Representative for evaluation and review as part of the open CAR.

The audit team determined that no significant adverse trends were identified during the audit. Overall, the CRWMS M&O is satisfactorily and effectively implementing an adequate corrective action process relative to Design Control processes.

6.0 RECOMMENDATIONS

The following recommendations resulted from the audit and are presented for consideration by CRWMS M&O management.

The Analysis BCAA00000-01717-0200-00010, *Evaluation of Ground Support Heating & Cooling Cycles*, was evaluated with the following comments: The analyses did not define what allowable stress levels were in either steel or concrete nor invoke industry consensus standards. Clarity of acceptance criteria needs to be further evaluated. Relative to control of design input, data was incorrectly transcribed from source documents (appeared to be editorial error). In some cases, assumptions were not clearly substantiated or justified (i.e., use of 2D versus 3D model). Additional documents were reviewed for same or similar problems and none were denoted.

It is recommended that management evaluate how acceptance criteria is identified and what industry consensus may apply to design products. The need to clearly justify assumptions needs to be re-emphasized to Design personnel.

2. The audit team raised questions relative to when "Design Verification" and

"independent design checking" are performed in accordance with Criterion III requirements and for type of design products. Issues revolve around past use of "package" concepts for design and current "products" concept and when we call a design complete. Interviewed personnel provided inconsistent responses relative to performing design verification. After a number of meetings and reviews of the independent checking criteria used by the CRWMS M&O, it was determined that the actions actually being performed meets the QA program requirements. (i.e., QARD, NQA-1, 10CFR50 Appendix B). It is not evident that CRWMS M&O design procedures clearly depict how the design verification or independent checking requirements are met and for what design products.

It is recommended that the CRWMS M&O clarify its AP-3.13Q (formerly QAP-3-0) procedure on Design Process and its DGM to clearly address the types of design products that are independently checked and those complex integrated design products that will go through an additional design review in accordance with the Design Verification procedure. It is also recommended that additional training of design personnel be performed to ensure consistent understanding of these processes.

3. Concerns exist relative to the adequacy of TDPPs for LADS QAP-3-5. reports (i.e., WP Self-Shielding and WP CRM reports. TDPPs do not clearly define inputs, criteria requirements, etc., expected to be used in developing the reports. (See Attachment I of procedure). It is recommended that personnel evaluate measures to ensuring that enough detail and specifics are provided in the TDPP to drive development of the document.

4. SDDs

Huddle Team Use During SDD Preparation

The procedure for preparation of SDD, NLP-3-33, does not identify the selection and use of huddle teams. These individuals are providing design input into the SDDs based on their knowledge and expertise. The huddle team members are not identified in any of the documentation resulting from the SDD development, except in some of the cover sheets in the Lotus Notes Database. However, the names in some cases are incorrect or do not appear at all.

It is recommended to include the selection and use of the huddle team in NLP-3-33 and identify them in the database or by some other documented method.

Project CPGPs

The Project CPGPs are developed for each SDD in accordance with NLP-3-36

specifically for use in the SDD development. These packages are developed based on the contents and scope of the SDD. The Packages contain all the applicable NRC "design criteria" that might impact a specific SDD. The Packages have the same process for check, review and approval as other design input. The Packages for several of the Revision 00 SDDs and some Revision 01 SDDs, were not available at the time of the SDD preparation or revision and not included. The procedure for SDD preparation, NLP-3-33, does not require input of the Package if not prepared.

Recommend that all new or revised SDDs that do not include input from an approved Project CPGPs clearly state this fact in the SDD. In addition, a strategy on completing and including the Packages in the SDDs should be developed.

Lotus Notes Database for SDDs

The Lotus Notes Database identifies SDDs and their revision status on a "cover sheet." The actual approved SDD can be viewed and printed from this database. The database SDD coversheet also contains the SDD schedule and the members of the huddle team. None of the coversheets reviewed contained scheduling information. Several did not contain the names of the huddle team members and in one case, for a SDD Revision 01, the author and huddle team members were those for Revision 00. For one SDD not yet started, which was originally drafted in 1997, the scope and title have been modified, but the attached draft reflects the original SDD title and scope. There is no explanation of why this draft still appears in the database. The auditor was told some portions would help the originator in the future.

Recommend using this resource to identify the huddle team members and keep the all the information up-to-date. Remove those sections of the coversheet that will not be maintained.

5. Checking: A process recommendation will be made relative to the methodology(s) utilized by the checking group. The problem is that the imaged check copies do not disclose the markup by the checkers. Most checkers following the DGM identify their "check" and "backchecks" in colors that are not picked up by the imaging process. Those "check" copies captured in the RIS is useless and the original maintained as "one of a kind" is difficult to retrieve. Other checkers are marking their copies in black ink which does image. The checking process is currently not being consistently performed (documented). It is recommended that the Engineering Services meet with Records and agree on a process that will meet the needs and desired efficiencies for both parties.

7.0 LIST OF ATTACHMENTS

Attachment 1: Personnel Contacted During the Audit
Attachment 2: Summary Table of Audit Results

ATTACHMENT 1

Personnel Contacted During The Audit

Name	Organization/Title	Preaudit Meeting	Contacted During Audit	Postaudit Meeting
M. Anderson	M&O WPO, Lead Engineer		X	
Robert Andrews	M&O PAO Manager	X	X	X
Fred Arth	M&O Engineering Staff Support	X	X	X
N. N. Bartley	M&O SEI/SDD		X	
John Beesley	M&O Engineering Services		X	X
Hugh Benton	M&O Waste Package Manager	X	X	X
Ron Berlien	M&O Regulatory & Licensing	X	X	X
K. K. Bhattacharyya	M&O Operations Mgr. EBSO	X	X	X
James Blaylock	OQA Verification Lead/Engineer			
David Calloway	M&O Project Information Management		X	
Z. Ceylan	M&O WPO Designer		X	
Robert Clark	OQA, Deputy Director		X	
J. K. Clark	M&O Deputy AGM	X	X	
John J. Clark	M&O Development Staff	X	X	X
Betty Cruz	M&O SE&I	X	X	X
Steve Dana	OQA/QATSS Quality Engineering	X	X	X
J. Wesley Davis	M&O WPO Lead		X	
George Dials	M&O General Manager	X		X
Thomas W. Doering	M&O Waste Package Design Manager		X	
Robert Dulin	M&O LADS	X		
V. A. Dulock	M&O Deputy Manager SEI		X	
Gloria Ferrereiro	M&O Training Department		X	
W. C. French	M&O Product Checking Group		X	
Matt Gomez	M&O Surface Design Engineer	X	X	X
Hank Greene	QATSS Manager Quality Systems	X	X	X
Gary Griffith	M&O Subsurface Operations Manager	X	X	X
E. P. McMann	M&O SEI/SDD Originator		X	
Robert Hasson	OQA/QATSS Audit Lead	X		X
Carl Hastings	M&O LADS Document Manager		X	
Larry Hayes	M&O NEPO Manager			X
G. C. Johnson	M&O SEI Product Checker		X	
Romeo Jurani	M&O Repository Design		X	
Judy Justice	M&O Training Supervisor	X		
Dave Keller	M&O Manager RPC		X	
K. Knapp	M&O WPO			X
Norman Kramer	M&O EBS Design		X	
A. Krug	M&O EBS Design		X	

Name	Organization/Title	Preaudit Meeting	Contacted During Audit	Postaudit Meeting
Christen Linden	M&O Subsurface Design		X	
Mike Lugo	M&O PMR Manager			X
Dan McKenzie	M&O EBSO Manager	X	X	X
J. Massari	M&O WPO Lead Engineer		X	
C. G. Mattsson	M&O Surface Design Manager		X	
E. P. McCann	M&O SDD Originator		X	
Mary McDaniel	OQA/QATSS Quality Systems			X
Scott McFeely	M&O/RSDD Lead Process Engineer	X		
Dan McKenzie	M&O Subsurface Design Manager		X	
Ray Mele	MTS Engineering Lead	X		X
H. Minwella	M&O SEI/Supervisor Project Compliance		X	
Robert A. Morgan	M&O Engineering Assurance		X	X
Ram Murthy	DOE/OQA Quality Systems			X
Lewis Neddo	M&O Project Information Manager			X
G. Nieder-Westermann	M&O Subsurface Design		X	
Richard M. Nolting	M&O EBS Design Lead		X	
Michael O'Neil	M&O EBS Design		X	
Ed Opelski	OQA/QATSS Verification Manager	X		
P. Pasupathi	M&O WPO Lead Design		X	
John W. Peters	M&O Engineering Services Manager	X	X	X
N. Pettit	M&O SIE/SDD Originator		X	
Paul Pierce	M&O EBS Design		X	
Michael Plinski	M&O WPO Lead		X	X
S. E. Salzman	M&O SEI		X	
Robert Saunders	M&O EBS Design Lead		X	
Randy Schreiner	M&O EBS	X		
Alden M. Segrest	M&O Deputy Manager PAO	X		
Richard D. Snell	M&O LADS Manager	X	X	X
Robert Stambaugh	M&O Requirements Department Manager		X	
Jeff Steinhoff	M&O EBS Engineer		X	
N. Sudan	M&O SEI/SDD Originator		X	
Steve Swenning	OQA/QATSS Quality Systems	X	X	X
Yiming Sun	M&O EBS Engineer		X	
C. B. Thom	M&O/SEI/SDD Supervisor		X	
Daniel Thomas	M&O/WPO Criticality Supervisor		X	
Kathleen Thompson	M&O Records Processing Center		X	
Gary Teraoka	M&O SEI/Systems Engineer		X	
Dan Tunney	OQA/QATSS Quality Systems			X
Vinod Vallikat	M&O PAO Lead		X	
Glen Vawter	M&O AGM	X		X
Michael Voegele	M&O Regulatory & Licensing	X		
Arthur Watkins	M&O EBS Engineer		X	
Dan Wilkins	M&O AGM Subsurface Systems	X	X	X

Name	Organization/Title	Preaudit Meeting	Contacted During Audit	Postaudit Meeting
Mary Woods	M&O Engineering Services Supervisor		X	
S. Harris-Womack	M&O Records Processing Center		X	
Jean Younker	M&O Deputy AGM	X	X	X
Fred Zinkevich	M&O LADS			X

LEGEND:

AGM	Assistant General Manager	QATSS	Quality Assurance Technical Support Services
EBS	Engineered Barrier System	OQA	Office of Quality Assurance
LADS	License Application Design Selection	PAO	Performance Assessment Operations
M&O	CRWMS Maintenance and Operating Contractor	NEPO	Natural Environmental Programs Office
SEI	Systems Engineering & Integration	RPC	Records Processing Center
YMP	Yucca Mountain Project	WPO	Waste Package Operations

ATTACHMENT 2

SUMMARY TABLE OF AUDIT RESULTS

QA ELEMENT/ ACTIVITIES	PROCESS STEPS/ MGMT OBJECTIVES	DETAILS (Checklist)	DEFICIENCIES	REC	PROCESS EFF.	PRODUCT ADEQUACY	OVERALL
3.0/ Design Control General WP/EBS/LADS/SDD	Appropriate Personnel assigned. (M/O/CPS)	I-1, I-7, III-7	N	N	SAT	SAT	SAT
	Training/qualification (M/O)	I-1, I-7, III-1	N	N	SAT	SAT	
	Value Added Practices, Compliance to DGM, Resource Management, Scoping (M/O)	I-3, IV-1, V-1	N	Rec.#2	SAT	SAT	
	Use of written procedures	I-9, II-3	N	N	SAT	SAT	
	Effectiveness of corrective actions from previous audits/ findings (MO)	I-5, I-4	N	N	SAT	SAT	
	Use/Effectiveness of Design Guidelines Manual (MO)	1-3, I-8	N	Rec.#5	SAT	SAT	
	M&O Interfaces for work at remote locations (MO)	I-2	N	N	SAT	SAT	
	Use of TBXs, unqualified data, input from external sources	I-12 thru I-14, III-9, V-2, VI-5	LVMO-99-C-002	N	SAT	UNSAT	

		VIII-4,IX-4					

QA ELEMENT/ ACTIVITIES	PROCESS STEPS/ MGMT OBJECTIVES	DETAILS (Cklst)	DEFICIENCIES	REC	PROCESS EFF.	PRODUCT ADEQUACY	OVERALL
3.0/ Design Control Critical Process Steps for Design Products EBS/WP/LADS	Control of *design inputs*: Inputs identified ;documented; selected; approved; traceable Identification and control of Aassumption based inputs@ (CPS)	I-12, I-13, II-4, III-4 III-9, III-10 IV-2,3,4; V-2,3; VI–1 thru 6, VII-2 VIII-5,6,7; IX-2,6,8,12-14	N	Rec.#1	SAT	SAT	SAT
	Control of *design process* : necessary detail /adequacy of design documents /standards identified and documented, /design methods, materials, parts, equipment, and processes selected and reviewed/use of information derived from documented experiences;ability to evaluate design without recourse to originator.	I-9, II-5, III-3, III-5, IV-3, V-4, V-5, VII-1, 3, 5;VIII-2,3 IX-7 thru 11	N	Rec.#1	SAT	SAT	
	Design analyses planned, doc umented: legibility, calculation computer software qualified, objectives, inputs, assumptions (CPS)	IV-5, IV-7, VI-8, VI-7, VII-5	N	Rec.#1	SAT	SAT	
	Technical Documents Development (CPS) Planning (TDPPs), sources, inputs, etc.	I-9,II-3,III-3,V-3,6 VIII-1,9,10, 13; IX-1,2, 3,5,8	N	Rec.#3	SAT	SAT	

	Design Interfaces(CPS)	III-8, VI-9	N	N	SAT	SAT	

QA ELEMENT/ ACTIVITIES	PROCESS STEPS/ MGMT OBJECTIVES	DETAILS (Cklst)	DEFICIENCIES	REC	PROCESS EFF.	PRODUCT ADEQUACY	OVERALL
	Checking/Review Process (CPS)	I-16, II-3, III-1, III-2 IV-6, VI-9	CDA* Records Issue	Rec.#5	SAT	UNSAT	SAT
	Change Control (CPS)	I-11,II-1	N	N	SAT	SAT	
	Design Outputs (CPS)	II-2, III-2, IV-8, V-4,6 VII-4, VIII-11,12,14;IX-5,14,15	N	N	SAT	SAT	
	Comment resolution (CPS)	II-1, II-2, III-2, III-6, IV-6	N	N	SAT	SAT	

	Control of Software (CPS)	I-15, VI-7, VIII-8,910 IX-12,13	N	N	SAT	SAT	

QA ELEMENT/ ACTIVITIES	PROCESS STEPS/ MGMT OBJECTIVES	DETAILS (Cklst)	DEFICIENCIES	REC	PROCESS EFF.	PRODUCT ADEQUACY	OVERALL
System Description Documents (SDD)	*Identification and Preparation* (CPS)	X-1 thru X-12	N	Rec.#4	SAT	SAT	SAT
	Reviewing and checking (CPS)	X-13 thru X-18	N	Rec.#4	SAT	SAT	
	Revisions and Changes (CPS)	X-19 thru X-20	N	Rec.#4	SAT	SAT	
	SDD Applications (CPS)	X-21 thru X-23	N		SAT	SAT	